The June–August adult recovery dates are similar to those reported in Eurasia (Bentinck & Diakonoff 1968, Bradley et al. 1979, Kuznetsov 1989), and suggests that *H. salicella* is bivoltine in North America. Details of wintering in Eurasia are unclear, but adult flight dates also suggest that the egg or partly grown larva is the wintering stage.

Specimens examined. North America: Vittoria, ON, 13-VIII-56, Freeman & Lewis, Canadian National Collection of Arthropods (CNC), Ottawa, ON; Cambridge, MA, 381 Walden St. at Concord Ave., 26-VI-75, R. Silberglied, at 15 w blacklight, male genit. slide WEM 911981, forewing length 9.0 mm, Museum of Comparative Zoology, Harvard, University, Cambridge, MA; 2 specimens, St. Johns, NF, reared VII-85, CNC; Brickyard Hill Wildlife Area, Atchison Co., MO, at blacklight, J. R. Heitzman, male genit. slide MS 97199, forewing length 9.0 mm, J. R. Heitzman collection, Independence, MO (Figs. 1 & 2). Europe: Derbyshire, England, 30-VI-25, H. C. Hayward, male genit. prep. WEM 291992, forewing length 9.5 mm; Mt. Kaiserstuhl, Baden-Württemberg, Germany, 6-VII-53, E. Jäckh, forewing length 10.0 mm; Capeila, Germany, 14-VII-42, Heddergott, male genit. prep. WEM 291991, forewing length 10.0 mm, all three in U. S. National Museum of Natural History, Smithsonian Institution, Washington, DC.

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LITERATURE CITED

BENTINCK, G. A., GRAAF & A. DIAKONOFF. 1968. De nederlandse Bladrollers (Tortricidae). Monogr. Nederl. Entomol. Ver. 3, 201 pp.

BRADLEY, J. D., W. G. TREMEWAN & A. SMITH. 1979. British tortricoid moths. Tortricidae: Olethreutinae. Ray Society, London. 336 pp.

KUZNETSOV, V. I. 1989. Leaf-rollers (Lepidoptera, Tortricidae) of the southern part of the Soviet Far East and their seasonal cycles, pp. 57–249. *In* O. L. Kryzhanovskii, (ed.), Lepidopterous fauna of the USSR and adjacent countries (translation). E. J. Brill, Leiden. 405 pp.

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A HOSTPLANT EXTENSION FOR *HEMILEUCA HERA HERA* (SATURNIIDAE: HEMILEUCINAE): THREETIP SAGEBRUSH (*ARTEMISIA TRIPARTITA* RYDB.)

Additional key words: sagebrush sheep moth, *Artemisia tridentata*, captive-rearing.

Big sagebrush, *Artemisia tridentata* Nutt. (Asteraceae), is widely documented as the exclusive hostplant for the sagebrush sheep moth, *Hemileuca hera hera* (Harris) (Ferguson 1971, McFarland 1974, Tuskes 1984, Stone 1991, Tuskes et al. 1996). In an investigation of insects in the upper Snake River Plain of southeastern Idaho, Stafford (1987) also found larvae of *H. hera hera* only on *A. tridentata* hosts, despite the presence of *A. nova* Nelson, *A. arbuscula* Nutt., and *A. tripartita* Rydb. at the study sites. The use of *Artemisia* species other than *A. tridentata* has been reported only by Collins (1974), who observed a small number of *H. hera hera* larvae on silver sagebrush, *A. cana* Pursh.

During a series of field surveys conducted to investigate the life history of *H. hera hera* in the same general area of southeastern Idaho studied by Stafford (1987), I commonly found larvae on *A. tridentata* ssp. *wyomingensis* (Beetle & Young). However, in one mixed-sagebrush community, I observed larvae at all stages of development feeding on both *A. tridentata* ssp. *wyomingensis* and *A. tripartita* ssp. *tripartita* (hereafter abbreviated as *A. tridentata* and *A. tripartita*). In 1997 and 1998, I reared captive larvae on *A. tripartita* for the purpose of obtaining voucher specimens. My observations of host associations and the results of captive-rearing are discussed in this note.

Field-observations. During April 1997, an intensive search was conducted of the area in which *H. hera hera* larvae were observed feeding on *A. tridentata* and *A. tripartita* hosts. Plants containing larvae were tagged and larval development was monitored weekly between May 1997 and July 1997. Larvae on both *A. tridentata* and *A. tripartita* demonstrated a life history and behavior typical of *H. hera hera* in other parts of its range. On both hosts, first through third instars generally fed gregariously and then dispersed to feed individually as fourth and fifth instars. On multiple occasions, late-instar larvae were observed to move from one *Artemisia* species to the other. Larvae often remained on the second host for several days, indicating that plants of both species were acceptable food sources.

Female *H. hera hera* in this study area also used both *A. tridentata* and *A. tripartita* as oviposition hosts (Hampton 2000). Eggs were most commonly laid on stems of both *Artemisia* species, but approximately 18% were located on the stems of other species in the sagebrush understory including *Chrysothamnus viscidiflorus* (Hook.) Nutt. (Asteraceae), *Leptodactylon*

pungens (Torr.) Nutt. (Polemoniaceae), and *Bromus tectorum* L. (Poaceae) (Hampton 2000). Despite these apparent oviposition "mistakes," feeding by larvae on plants other than *Artemisia* spp. was observed only once. In the spring of 1997, several larvae developed to the third instar while feeding on green rabbitbrush (*C. viscidiflorus*). However, compared to larvae feeding on nearby sagebrush, these larvae were severely stunted. Continued searches of this plant showed no evidence that the larvae matured or pupated.

Previously documented instances of *H. hera hera* feeding on plants of genera other than *Artemisia* are also rare. Collins (1974) reported a single *H. hera hera* larva feeding on lupine (*Lupinus* sp., Fabaceae) and use of buckwheat (*Eriogonum* spp., Polygonaceae) has been reported (Tuskes 1984). These observations have been generally attributed to "adventitious" feeding or conditions associated with larval overcrowding (Collins 1974, Tuskes 1984).

Captive-rearing. During late June and early July of 1997, I collected 31 fourth and fifth instar *H. hera hera* larvae from plants of both *A. tridentata* and *A. tripartita* for the purpose of obtaining adult voucher specimens (archived in the entomology collection at Idaho State University, International Collection Registry ICIS).

Larvae were fed on potted *A. tripartita* plants located in screened outdoor cages. The cages were constructed of rigid wire mesh rolled into free-standing cylinders approximately 0.60 m in diameter. The cylinders were covered with 1 mm mesh nylon screen, placed over potted sagebrush plants resting on soil-filled bases of equal diameter, and pressed into the soil to form an escape-proof seal. By 21 July 1997, 22 of the 31 caterpillars had successfully pupated. On 10 November 1997, the soil-covered pupae were moved to an unheated garage where they were left in diapause. In April 1998, the cages were reconstructed and the pupae were returned to the outdoors to await eclosion. Five adult *H. hera hera* (3 females and 2 males) emerged between 11 and 26 August 1998 (see Table 1). In early September 1998, the soil bases of all cages were excavated and four potentially viable pupae were transferred to small containers and moved indoors. Two of the pupae in containers subsequently produced adults, one female on 12 September 1998, and a male on 2 October 1998. Of the 22 pupae produced in 1997, 15 were lost to various causes including parasitism by a fungus and an unidentified wasp (Ichneumonidae: Hymenoptera) (Table 1).

In April 1998, a group of first instar larvae collected from *A. tridentata* were reared in the same manner, using the same cages and *A. tripartita* plants. Cold, wet weather killed all but seven of the approximately 25 larvae during their second molt. However, the size and vigor of the remaining larvae appeared similar to larvae observed in the field and all seven pupated by late July 1998. When cages were dismantled in early September 1998, three pupae had been destroyed by a fungal parasite. Four undamaged pupae were removed from the soil to small containers and refrigerated during November 1998 through March 1999. Three adults (1 male and 2 females) emerged between 3 and 9 August 1999 (Table 1). However, two of these individuals were dark–colored, appeared weak, and the wings of both never fully expanded.

TABLE 1. Summary of captive-rearing results.

	1997–1998	1998–1999
No. of initial larvae	31[a]	25[b]
No. of pupae produced	22 (71%)	7[c] (28%)
No. of adults produced[d]	7[e] (23%)	3[e] (12%)
No. of unsuccessful pupae	15[e] (48%)	4[e] (16%)
Damaged in handling	1	—
Fungal parasites	7	3
Ichneumonid parasitoid	3	—
Other insect damage	1	—
Unknown causes	3	1

[a] Fourth and fifth instars collected between June and July 1997.

[b] Estimated number of first instars collected as an aggregation in April 1998.

[c] All but seven larvae were killed by cold, wet weather conditions that occurred as larvae were molting from second to third instars.

[d] Dates of emergence for seven 1998 adults: ♂ 11 Aug., ♀ 23 August, ♂ 24 Aug., ♀ 26 Aug., ♀ 27 Aug., ♀ 12 Sept.[f], and ♂ 2 Oct.[f] Dates of emergence for three 1999 adults: ♀ 3 Aug., ♂ 8 Aug., and ♀ 9 Aug.

[e] Total based on the assumption that adults emerged from 1997 pupae (see item "f" below).

[f] Late dates of adult eclosion may indicate same-year emergence.

The potential for alternative hosts. Fourteen species of *Artemisia* and 11 subspecies in the subgenus *Tridentatae* are found within the western United States (McArthur et al. 1998, McArthur 2000). Although *A. tridentata* and its subspecies have the greatest geographic range (McArthur 2000) and are found throughout the range of *H. hera hera* (Fig. 1), the distributions of most members of the subgenus intersect the moth's range to some extent. The northeastern range of *H. hera hera* extends well outside the range of *A. tridentata* (Fig. 1) and beyond the ranges of all *Artemisia* species except *A. cana* (McArthur & Plummer 1978), indicating the potential for an alternate host in that area.

Artemisia tripartita ssp. *tripartita* is generally restricted to areas of Idaho, Washington, and Oregon (Shultz 1984), and occurs only in the central portion of the range of *H. hera hera* (Fig. 1). A second subspecies, *A. tripartita* ssp. *rupicola* Beetle, inhabits large areas of Wyoming (Beetle 1960, Shultz 1984). Although plant morphology differs markedly between *A. tripartita* and

A. tridentata, early leaf growth in both species (Miller & Shultz 1987) coincides with larval emergence (pers. obs.), and chemical constituents of both are similar (Kelsey & Shafizadeh 1979). However, differences in plant structure are known to influence microclimatic conditions within and around plants (Hinds & Rickard 1968, Lawton 1983, Strong et al. 1984, Pierson & Wight 1991) and can impact selection of oviposition site, larval survivorship and development, and predation dynamics in *H. hera hera* (Hampton 2000). Unlike most woody *Artemisia* species, *A. tripartita* plants can re-sprout from the roots after fire, over-grazing, or winter damage (Beetle 1960, Hironaka et al. 1983). Because *A. tridentata* plants are easily killed by fire (Beetle 1960) and take many years to regenerate from seed (Hironaka et al. 1983), the use of *A. tripartita* as an alternative host could have important implications with regard to long-term survival and viability of *H. hera hera* populations. This may be especially important in the wake of more frequent wildfire and other large-scale disturbances to sagebrush communities across the Great Basin (Knick & Rotenberry 1997, Knick 1999).

Another subspecies of *H. hera* is also known to use more than one hostplant. Both *A. tridentata* and *A. filifolia* Torr. are used as hosts by *H. hera magnifica* (Rotger), depending on the location within its range (Stone & Smith 1990, Stone et al. 1988). Because *Artemisia* species and subspecies share many chemical similarities (Kelsey & Shafizadeh 1979), it may be reasonable to expect that other species might also serve as suitable foodplants for *H. hera hera*. Nevertheless, some herbivorous insects demonstrate apparent preferences for certain subspecies and hybrids of *A. tridentata* (Messina et al. 1996) and there is evidence that some *Artemisia* species and varieties can be unsuitable hosts for *H. hera hera* larvae (McFarland 1974, Tuskes et al. 1996). The variation in secondary chemistries of *Artemisia* species and hybrids (McArthur et al. 1988, Messina et al. 1996) may influence the selection of hosts by *H. hera hera*. Although hybridization between *A. tridentata* ssp. *wyomingensis* and *A. tripartita* is a possibility, it has not been documented (B. L. Welch, pers. com.) and attempts to produce hybrids under controlled conditions have been unsuccessful (McArthur et al. 1998).

The use of other species and varieties within the genus *Artemisia* by *H. hera hera* may simply not appear more frequently in the literature because sagebrush identification and taxonomy is complicated. Prior to 1960, several species were included as subspecies within the *A. tridentata* complex (Hall & Clements 1923), but were assigned species status in later treatments (Beetle 1960, McArthur et al. 1998). For example, *A. tripartita* was formerly classified as *A. tridentata* ssp. *trifida* Hall & Clements (Hall & Clements 1923). Although leaf and plant morphologies of *A. tripartita* are distinctive, hostplant nomenclature to the level of subspecies is rarely, if ever, included in published food records for *H. hera hera*. Consequently, some accounts could refer to a number of *Artemisia* species formerly designated as subspecies of *A. tridentata*.

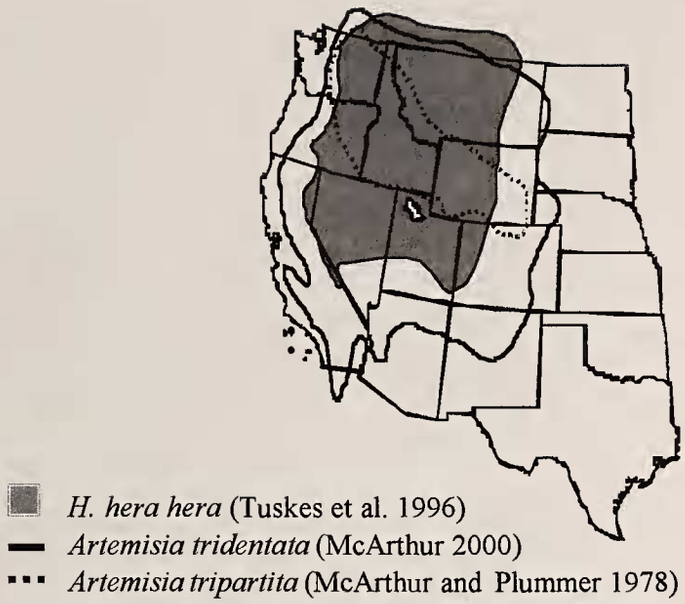

FIG. 1. The ranges of *Hemileuca hera hera* and *Artemisia* hostplants.

The use of *A. tripartita* by *H. hera hera* in southeastern Idaho provides new evidence that the sagebrush sheep moth can successfully exploit hosts other than *A. tridentata* in some parts of its range. The potential use of alternative *Artemisia* hosts by *H. hera hera* in other geographical locations, including *A. cana* in the northeastern extension of its range, warrants further investigation.

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LITERATURE CITED

BEETLE, A. A. 1960. A study of sagebrush: The section Tridentatae of *Artemisia*. Bulletin No. 363, Wyoming Agricultural Experiment Station, University of Wyoming, 83 pp.

COLLINS, M. M. 1974. The population dynamics of moths in the genus *Hemileuca* on Monitor Pass, California. Unpublished master's thesis, California State University, Hayward, California.

FERGUSON, D. C. 1971. Bombycoidea: Saturniidae. Moths of North America. Fascicle 20.2A. E. W. Classey Ltd., London. 153 pp.

HALL, H. M. & F. E. CLEMENTS. 1923. The phylogenetic method in taxonomy: the North American species of *Artemisia*, *Chrysothamnus*, and *Atriplex*. Publ. Carnegie Inst. Wash. 326:1–355.

HAMPTON, N. L. 2000. Hostplant selection and egg placement as factors influencing egg survival in *Hemileuca hera hera* (Saturniidae: Lepidoptera). Unpublished master's thesis, Idaho State University, Pocatello, Idaho.

HINDS, W. T. & W. H. RICKARD. 1968. Soil temperatures near a desert steppe shrub. Northwest Sci. 42(1):5–13.

HIRONAKA, M., M. A. FOSBERG & A. H. WINWARD. 1983. Sagebrush-grass habitat types of southern Idaho. University of Idaho Forest, Wildlife, and Range Bulletin, No. 35, Moscow, Idaho. 44 pp.

KELSEY, R. G & F. SHAFIZADEH. 1979. Sesquiterpene lactones and systematics of the genus *Artemisia*. Phytochem. 18:1591–1611.

KNICK, S. T. 1999. Requiem for a sagebrush ecosystem? Northwest Sci. 73(1):53–57.

KNICK, S. T. & J. T. ROTENBERRY. 1997. Landscape characteristics of disturbed shrubsteppe habitats in southwestern Idaho (U.S.A.). Landscape Ecol. 12:287–297.

LAWTON, J. H. 1983. Plant architecture and the diversity of phytophagous insects. Ann. Rev. Entom. 28:23–39.

MCARTHUR, E. D. 2000. Sagebrush systematics and distribution. Pages 9–14. *In* P. G. Entwistle, A. M. Debolt, J. H. Kaltenecker & K. Steenhof (compilers). Proceedings: Sagebrush Steppe Ecosystems Symposium. Bureau of Land Management Publication No. BLM/ID/PT-001001 + 1150, Boise, Idaho, U.S.A.

MCARTHUR, E. D. & A. P. PLUMMER. 1978. Biogeography and management of native western shrubs: A case study, section Tridentatae of *Artemisia*. Intermountain Biogeography: A Symposium. Great Basin Nat. Memoirs. 2:229–243.

MCARTHUR, E. D., B. L. WELCH & S. C. SANDERSON. 1988. Natural and artificial hybridization between big sagebrush (*Artemisia tridentata*) subspecies. J. Heredity 79:268–276.

MCARTHUR, E. D., J. MUDGE, R. VAN BUREN, W. R ANDERSON, S. C. SANDERSON & D. G. BABBEL. 1998. Randomly amplified polymorphic DNA analysis (RAPD) of *Artemisia* subgenus *Tridentatae* species and hybrids. Great Basin Nat. 58:12–27.

MCFARLAND, N. 1974. Notes on three species of *Hemileuca* (Saturniidae) from eastern Oregon and California. J. Lepid. Soc. 28:136–141.

MESSINA, F. J., J. H. RICHARDS & E. D. MCARTHUR. 1996. Variable responses of insects to hybrid versus parental sagebrush in a common garden. Oecologia 107:513–521.

MILLER R. F. & L. M. SHULTZ. 1987. Development and longevity of ephemeral and perennial leaves on *Artemisia tridentata* Nutt. ssp. *wyomingensis*. Great Basin Nat. 47(2):227–230.

PIERSON, F. B. & J. R. WICHT. 1991. Variability of near-surface temperature on sagebrush rangeland. J. Range Man. 44:491–497.

SHULTZ, L. M. 1984. Taxonomic and geographic limits of *Artemisia* subgenus Tridentatae (Beetle) McArthur (Asteraceae: Anthemideae). Pages 20–28. *In* E. D. McArthur, B. L. Welch (compilers). Proceedings—Symposium on the Biology of *Artemisia* and *Chrysothamnus*, July 9–13 1984, Provo Utah. Genera Technical Report INT-200, USDA, Forest Service, Intermountain Research Station, 1986, 398 pp.

STAFFORD, M. P. 1987. Insect interactions with four species of sagebrush (*Artemisia*) in southeastern Idaho. Unpublished doctoral dissertation, University of Idaho, Moscow, Idaho.

STONE, S. E. 1991. Foodplants of world Saturniidae. Memoir Number 4, The Lepidopterists' Society.

STONE, S. E. & M. J. SMITH. 1990. Buckmoths (Lepidoptera: Saturniidae: *Hemileuca*) in relation to southwestern vegetation and foodplants. Desert Plants 10 (1):13–30.

STONE, S. E., D. E. SWIFT & R. S. PEIGLER. 1988. The life history of *Hemileuca magnifica* (Saturniidae) with notes on *Hemileuca hera marcata*. J. Res. Lepid. 26(1–4):225–235.

STRONC, D. R., J. H. LAWTON & R. SOUTHWOOD. 1984. Insects on plants, community patterns and mechanisms. Harvard University Press, Cambridge, Massachusetts.

TUSKES, P. M. 1984. The biology and distribution of California Hemileucinae (Saturniidae). J. Lepid. Soc. 38:281–309.

TUSKES, P. M., J. P. TUTTLE & M. M. COLLINS. 1996. The wild silkmoths of North America: A natural history of the Saturniidae of the United States and Canada. Cornell Univ. Press, Ithaca, New York. 250 pp.

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REDISCOVERY OF AND NOTES ON *XANTHOTHRIX RANUNCULI* FORM *ALBIPUNCTA* BARNES & BENJAMIN, 1925 (NOCTUIDAE: STIRIINAE)

Additional key words: discal spot, *Coreopsis*.

Barnes and Benjamin (1925) described *albipuncta* as a form of *Xanthothrix ranunculi* based on two individuals, a male holotype and a female allotype, collected 10 April 1902 at Kaweah, Tulare Co., California. The moths were described as having "head, thorax and forewing black dusted with olivaceous, the latter with a round white spot near end of cell. Secondaries blackish."

Xanthothrix ranunculi was described by Henry Edwards (1878) from Havilah, Kern Co., California, and most specimens seen are from Lovejoy Buttes, Los Angeles Co., California. These moths were described as, "Primaries wholly rich buff, sometimes pale orange when very fresh, but upon some scales being removed, showing a blackish tint. Secondaries, dusky along the costa, apical margin and at base, buff in the center, and towards the anal angle. . ." Comstock and Henne (1940) described their early stages, and reported the hostplant is *Coreopsis douglasii* (Asteraceae). Poole (1994) makes no mention of form *albipuncta*.

On 21 March 1990, I collected three individuals of a small moth flying near *Coreopsis stillmanii* (Asteraceae) on a steep, south-facing slope above the middle fork of the American River, 13 mi. NE of Auburn, Placer Co., California. One, a worn specimen, fit the description of *Xanthothrix ranunculi* form *albipuncta*; the two fresh specimens had gold forewings with a light yellow spot near the end of the cell. The habitat consisted of annual grasses and flowering plants surrounded by foothill woodland. At the same locality, in March 1998 the moths were numerous and were often seen sitting on the *Coreopsis* flower heads. More individuals were collected and the association with *Coreopsis* observed. Alvin Ludtke collected females and *Coreopsis still-*